Fisheries Centre

The University of British Columbia

Working Paper Series

Working Paper #2015 - 72

Fisheries in troubled waters:
A catch reconstruction for Guinea-Bissau, 1950-2010

Dyhia Belhabib and Daniel Pauly

Year: 2015

Email: d.belhabib@fisheries.ubc.ca

FISHERIES IN TROUBLED WATERS: A CATCH RECONSTRUCTION FOR GUINEA-BISSAU, 1950-2010

Dyhia Belhabib and Daniel Pauly

Sea Around Us, Fisheries Centre, University of British Columbia, 2202 Main Mall, Vancouver, BC, V6T 1Z4, Canada

Corresponding author : d.belhabib@fisheries.ubc.ca

ABSTRACT

Marine fisheries catches of Guinea Bissau were reconstructed to account for sectors that have never been considered previously. Two main sectors were identified, the large-scale (industrial) sector, which includes foreign industrial catches, the catches of so-called 'domestic' vessels, and the discards they both generate. The other main sector is the small-scale sector, including subsistence, recreational and, most importantly, the artisanal sectors. Catches were estimated at 13.0 million tonnes between 1950 and 2010, of which 1.6 million tonnes were caught by domestic fisheries.. This is much higher than the 207,000 tonnes supplied to the FAO on behalf of Guinea Bissau. A sharp decline in catches is noted over the last decade, probably due to over-exploitation which threatens the food security of the population of Guinea-Bissau. On the other hand, losses due to illegal fisheries are very high, and controlling illegal fishing will go a long way towards improving the status of the fisheries of, and seafood reported by Guinea Bissau.

INTRODUCTION

Guinea Bissau is located at the edge of the Guinea Current Large Marine Ecosystem (LME) and the Canary Current LME between 11°52'N and 15°36'W. Thanks to coastal upwelling and extensive nutrients from river input, the extensive continental shelves off Guinea Bissau – one of the largest in West Africa – within an Exclusive Economic Zone of 106,000 km^2 (Figure 1) is home to an estimated one million tonnes of fisheries resources, of which, optimistically, 350,000 to 500,000 tonnes can be extracted annually (Anon. 2009).

The history of Guinea Bissau could be described as eventful. Following independence from Portuguese colonial rule in 1974, after a long war of liberation, the first government was overthrown, and it was only twenty years later that the first democratic elections were held. A civil war occurred after a few years, in 1998, followed by a first *coup d'état* in 1999 and another in 2003. In 2004, the mutiny of a military faction again caused unrest, and eventually led, in 2009, to another *coup d'état*, after which a new government was elected. The sudden death of the newly elected president in 2012 led to another *coup d'état*. Unsurprisingly, these events stifled the development, economic and otherwise, of Guinea Bissau, now listed as one of the poorest countries in the world (www.worlbank.org), see also Fernandes (2012).

This, along with agricultural resources limited almost exclusively to cashew nuts, left fisheries as one of the few avenues for economy growth and food security (Dia and Bedingar 2001), although the people of Guinea Bissau were seen as "lazy fishers" in colonial times because they lacked a strong fishing tradition (Bordonaro 2006).

Yet, although the country's official statistics show that Guinea Bissau strongly depends on one export commodity – with 99% of the exports, Guinea Bissau is more dependent on cashew nuts than Nigeria is on oil – the fees from foreign fishing access agreements account for 40% of government revenues. This figure, which is among the highest in the world (Anon. 2013), demonstrates how important fishing is to the country's economy (Anon. 2010).

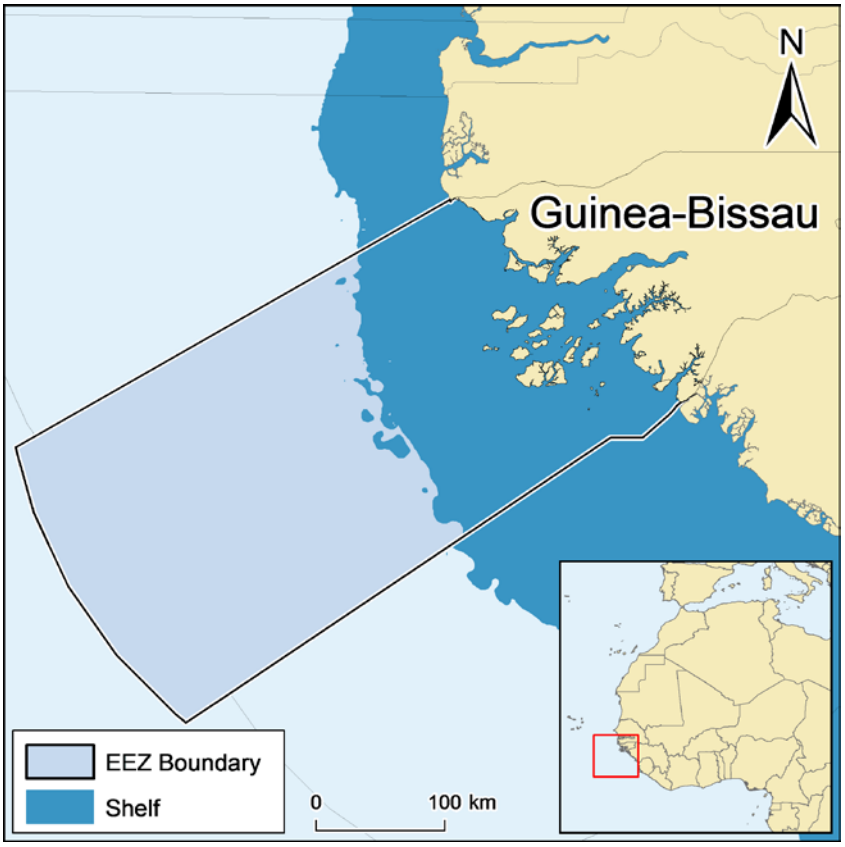

Figure 1: Map of Guinea-Bissau with its Exclusive Economic Zone (EEZ).

While legal foreign fishing started in 1978, with the first agreement signed with the former Soviet Union (DINÂMICA 2008), the first management plan ever to be implemented was only promulgated in 1996 (Anon. 2009). Other management plans dealt with capacity limits and total allowable catch, but given the very poor statistics and other constraints, the objectives of the plans were not met (Anon. 2009), repeating the unfortunate experience of fisheries development projects in the 1970s (Bordonaro 2006). Meanwhile, fish biomass in the Exclusive Economic Zone (EEZ) of Guinea-Bissau appears to have declined to at least 50% of its value in 1963, when the first acoustic survey was conducted, by '*la Rafale*' (Anon. 2009).

Official figures indicate that fisheries in Guinea Bissau consist of two main sectors. The artisanal sector relies on dugout canoes called *nhominkas*, of which about one quarter are motorized, and Senegalese-type pirogues of which 83% are motorized (Anon. 2009). The industrial sector consists of licensed foreign vessels, some of which are chartered and fly the flag of Guinea Bissau (Dia and Bedingar 2001). A thorough literature search revealed however, the existence of other sectors, i.e., subsistence fishing, conducted mostly by women, and recreational fishing, popular among expatriates in Guinea-Bissau, and occurring in over twenty islands of the Bijago Archipelago. Finally, there are discards generated by the industrial fishing sector, and the illegal foreign fishing sector, as elsewhere in West Africa.

There is no regular monitoring system for fisheries in Guinea Bissau, but surveys were conducted by the Department of Fisheries in 1998, 2001 and 2003 (INS 2009), which included the number of pirogues and fishers, and estimates of the artisanal catch. Industrial catches are based on industry declarations and are grossly under-estimated (Dia and Bedingar 2001).

The present study presents the first exhaustive and comprehensive estimation of total marine and estuarine fisheries withdrawals from the waters of Guinea Bissau, including all the sectors alluded above for over six decades.

METHODS

Artisanal fishing

In contrast to its neighbours, notably Senegal, Guinea Bissau does not have a long-standing fishing tradition (Campredon and Cuq 2001), and while in the past, *nhominkas* were commonly used, artisanal fishing by locals started only in the mid-1970s (Tvedten 1990; Chavance 2004). Thus, here the artisanal sector is divided into two categories, distinguished by the craft used, Senegalese *nhominka* pirogues and local dug-out canoes, or *pailão*, which have a capacity that is a third of that of the Senegalese *nhominka* pirogue (Tvedten 1990).

Three major surveys were conducted in Guinea Bissau to estimate total artisanal effort for 1998, 2001 and 2003 (INS 2009), while the artisanal catch data included only the fish sold through the main market places up to the early 1990s, thus leaving a large part of catches unreported (Tvedten 1990; Kebe *et al.* 1993). Effort data were scattered across the literature and used unless contradictory; numbers that appeared too low or too high compared to the general average were not used. Total effort, i.e., the number of pirogues, was interpolated to complete the estimate for intervening years (Table 1). Using the few anchor points documenting the effort by category (Table 1), we estimated, and then interpolated the percentage of each category. We obtained the effort per category for the remaining years by multiplying the resulting rates (percentage of *nhominka* and *pailão* pirogues over the total) by the total number of pirogues (Table 1).

For 1990, Tvedten (1990) estimated a CPUE of 4.16 t·pirogue^{-1}·month^{-1} for 8 months fishing, i.e., 33.2 t·pirogue^{-1} for the *nhominka* pirogues. For 2001, *nhominka* CPUE was estimated at 150 kg·pirogue^{-1}·day^{-1} for 200 fishing days, i.e., 30 t·pirogue^{-1} (Dia and Bedingar 2001). Similarly, Tvedten (1990) documented a 1990 CPUE of 9.6 t·canoe^{-1} for the *pailão*. Assuming the same decreasing trend for CPUEs to 2001, we applied the percentage of change observed for the *nhominka* CPUE to the *pailão* CPUE, and estimated the latter at 8.67 t·canoe^{-1} for 2001. Given the clear signs of over-exploitation (Anon. 2009), we assumed the CPUE was a conservative 10% higher in 1950 compared to that in 1990. We interpolated to fill the gaps, and extrapolated the trend forwards from 2001 and 2010 to reflect on the decrease of CPUEs. The artisanal catch per category is the product of the effort and the CPUE of each category. Taxonomically, species caught by the artisanal sector are those used for local consumption. They include estuarine species like bonga shad (Dia and Bedingar 2001) and demersal species (Table 2).

Migrant fisher catches

Migrant fishers are here defined as foreign artisanal fishers operating on pirogues and landing their catches outside Guinea Bissau. The most common case in Northwest Africa is the Senegalese migrant fishing activity. Their catches were estimated by Belhabib *et al.* (this volume) as the product of the effort (number of Senegalese pirogues x number of trips) by the CPUE per trip. For purposes of the *Sea Around Us*, these Senegalese catches taken in Guinea Bissau waters are treated as 'industrial', despite being of 'semi-industrial' or even 'large' artisanal nature.

Subsistence fishing

Prior to the independence of Guinea Bissau from Portugal in 1974, fishing was primarily for subsistence (DINÂMICA 2008). Subsistence fishing is carried out by many people along Guinea Bissau's coastline (Anon. 2009). Some authors reported that most of the coastal population practice subsistence fishing (Said 2007), others allude to thousands of women and subsistence fishers operating in Guinea Bissau (Garcia 1992) and providing more animal protein than any other sectors for local consumption (Anon. 1994). This is compatible with the observation that almost all the animal protein consumed in Guinea Bissau comes from fish (Anon. 2009).

For 1979, Garcia (1992) reported a (survey-based) consumption rate of 28 kg·person^{-1}·year^{-1}, relying mostly on artisanal and subsistence catches, complemented by occasional imported fish. By multiplying the *per capita* fish consumption by the total population of 1,033,000 (Garcia 1992), we estimated a total fish supply of 28,924 t for 1979. We removed that part of industrial catches landed in Guinea, corresponding to 6,303 t·year^{-1} (COPACE 1981), the imports (caught outside Guinea Bissau) and exports (unavailable to fish consumers) of 260 t·year^{-1} and 4,435 t·year^{-1}, respectively. Therefore, we estimated a total small-scale catch of 17,661 t·year^{-1}. Given that a significant part of fish consumption is from subsistence fishing, women in estuarine waters, on beaches, or from household subsistence activities (Garcia 1992), we assumed 40% of the previous small-scale supply was generated by subsistence fishing, i.e., 7,064 t in 1979. We divided this catch by the total population to obtain a *per capita* consumption supported by subsistence fisheries (6.8 kg·person^{-1} for 1979). Given the evidence of a higher consumption rate from subsistence fishing in the past (before independence), when most catches were from the subsistence sector, we conservatively assumed this catch rate was 50% higher in 1950, i.e., 10.2 kg·person^{-1}, 30% higher in 2000 than in 1979 (8.9 kg·person^{-1}) due to the decline in artisanal supply during the civil war, and the shift of subsistence fishing to market artisanal fishing during the 1980s and 1990s (Tvedten 1990). Dia and Bedingar (2001) reported a consumption rate of 26 kg·person^{-1}·year^{-1} for the last decade. Thus, by following the same approach as for 1979, but assuming a lower rate for subsistence fishing (35%), and with landings of 6,650 t and imports and exports of 1,456 t and 4,526 t, respectively, we estimated the subsistence catch at 16,735 t for 2010. Table 3 summarizes the methods used. We then interpolated between these estimates to complete the time series.

Table 1. Artisanal effort anchor points. Italics indicate interpolations and calculated values. (note that 100% - % *nhominka* effort =national effort)

Year	Total effort	Source	*Nhominka*		
			Effort	%	Source[c]
1950	195	Chavance (2004)	195	100	Assumption
1951	195	Chavance (2004)	*195*	100	
1952	215	Chavance (2004)	*215*	100	
1953	234	Chavance (2004)	*234*	100	
1954	254	Chavance (2004)	*254*	100	
1955	273	Chavance (2004)	*273*	100	
1956	313	Chavance (2004)	*313*	100	
1957	313	Chavance (2004)	*313*	100	
1958	313	Chavance (2004)	*313*	100	
1959	313	Chavance (2004)	*313*	100	
1960	313	Chavance (2004)	*313*	100	
1961	313	Chavance (2004)	*313*	100	
1962	352	Chavance (2004)	*352*	100	
1963	352	Chavance (2004)	*352*	100	
1964	352	Chavance (2004)	*352*	100	
1965	352	Chavance (2004)	*352*	100	
1966	391	Chavance (2004)	*391*	100	
1967	352	Chavance (2004)	*352*	100	
1968	430	Chavance (2004)	*430*	100	
1969	430	Chavance (2004)	*430*	100	
1970	391	Chavance (2004)	*391*	100	
1971	430	Chavance (2004)	*430*	100	
1972	469	Chavance (2004)	*469*	100	
1973	547	Chavance (2004)	*547*	100	
1974	547	Chavance (2004)	*520*	*95*	Tvedten (1990)[a]
1975	547	Chavance (2004)	*493*	*90*	Interpolation
1976	547	Chavance (2004)	*467*	*85*	Interpolation
1977	547	Chavance (2004)	*440*	*80*	Interpolation
1978	547	Chavance (2004)	*413*	*75*	Interpolation
1979	586	Chavance (2004)	*414*	*71*	Interpolation
1980	586	Chavance (2004)	*385*	*66*	Interpolation
1981	586	Chavance (2004)	*356*	*61*	Interpolation
1982	625	Chavance (2004)	*349*	*56*	Interpolation
1983	664	Chavance (2004)	*339*	*51*	Interpolation
1984	625	Chavance (2004)	*288*	*46*	Interpolation
1985	850	Weber and Durand (1986)	*350*	*41*	Interpolation
1986	664	Chavance (2004)	*241*	*36*	Interpolation
1987	703	Chavance (2004)	*221*	*31*	Interpolation
1988	1,094	Chavance (2004)	*290*	*26*	Interpolation
1989	1,445	Chavance (2004)	*312*	*22*	Interpolation
1990	1,836	Chavance (2004)	306	17	Tvedten (1990)[b]
1991	1,797	Chavance (2004)	*307*	*17*	Interpolation
1992	1,836	Chavance (2004)	*322*	*18*	Interpolation
1993	1,836	Chavance (2004)	*330*	*18*	Interpolation
1994	1,914	Chavance (2004)	*352*	*18*	Interpolation
1995	1,914	Chavance (2004)	*361*	*19*	Interpolation
1996	1,953	Chavance (2004)	*376*	*19*	Interpolation
1997	1,914	Chavance (2004)	*377*	*20*	Interpolation
1998	1,953	Chavance (2004)	*393*	*20*	Interpolation
1999	1,953	Chavance (2004)	*402*	*21*	Interpolation
2000	2,490	Dia and Bedingar (2001)	*523*	*21*	Interpolation
2001	*2,379*	Interpolation	512	21	Dia and Bedingar (2001)
2002	*2,269*	Interpolation	*466*	*21*	Interpolation
2003	*2,158*	Interpolation	*425*	*20*	Interpolation
2004	*2,048*	Interpolation	*385*	*19*	Interpolation
2005	*1,937*	Interpolation	*347*	*18*	Interpolation
2006	*1,827*	Interpolation	*311*	*17*	Interpolation
2007	*1,716*	Interpolation	*277*	*16*	Interpolation
2008	*1,606*	Interpolation	*245*	*15*	Interpolation
2009	1,495	Anon. (2009)	215	14	Anon. (2009)
2010	1,495	IRD (2011)	215	14%	IRD (2011)

a) artisanal national fishing started here;
b) *Nhominka* pirogues represented around 17% of the total in the area sampled;
c) the number of *pailão* canoes is obtained as the difference between the total effort and the *nhominka* effort.

Table 2. Species composition of the artisanal sector catches in Guinea Bissau. Numbers from 1993 to 2003 converted to percentages and then averaged (ECOST 2007).

Scientific name	Common name	Percentage
Ethmalosa fimbriata	Bonga shad	54
Argyrosomus regius	Meagre	17
Penaeidae	Shrimps	10
Cynoglossus spp.	Soles	9
Carlarius heudelotii	Smoothmouth sea catfish	6
Caranx spp.	Carangids (jacks)	2
Pomadasys jubelini	Sompat grunt	1

Taxonomically, catches from mangrove-rich areas and/or the Bijagos Islands constitute a significant part of subsistence fisheries. Therein, molluscs gathered by women, mainly wild oysters (*Crassostrea gasar*), arks (*Anadara senilis*) and murex shells (*Murex* spp.) represent the dominant taxa, assumed here to make up 80% of the catch, divided evenly by the three above taxa. The remaining 20% are assumed to have the same taxonomic composition as the artisanal catches (see Table 2), with shrimp catches (2%) (Failler 2005) consisting mainly of white shrimp (*Farfantepenaeus notialis*; 73 %) and tiger shrimp (*Penaeus monodon*; 26%).

Table 3. Summary of the methods used to estimate subsistence catches in Guinea Bissau.

Year	Population	Consumption	kg·person^{-1}	Notes
1950	518,888	80% higher than in 1979	10.2	Part of the per capita consumption that comes from subsistence
1979	1,033,000	[28 x Population - Landings - (Imports +Exports)] x 0.4	6.8	Estimated as 40% of the supply from small scale
2000	1,241,000	30% increase due to the decrease in artisanal supply	8.9	During the civil war, pirogues have been stolen
2010	1,515,000	[26 x Population - Landings - (Imports +Exports)] x 0.35	11.0	No significant change in fish consumption since 2000

Recreational fishing

Sport fishing is apparently a notable segment of tourism in the Bijagos archipelago (Anon. 2010), but little information is available on the number of visitors to the archipelago, or the number of tourists using the services of fishing 'safaris'. Anon. (2010) reported the total number of international standard beds made available for tourists at 76 daily for 2001, each stay lasting 10 days at average, for 6 days fishing[1;2] during a tourist season lasting 6 months, which represents a potential of 1,387 tourists (Table 4). For 2012, the camps established for tourists in Guinea Bissau were visited by 1,200 persons, of which only 50% went fishing. There also were between 150 and 350 fishers (250 on average) for each of 4 other camps, and 500 visitors per year to a near-shore hotel, of which only a minority (20%) went fishing (Pierre Campredon, IUCN Guinea Bissau, pers. comm.). Therefore, the overall number of recreational fishers for 2012 was estimated as the sum of fishers for each camp and/or hotel, i.e., 1,500 fishers. We assumed that recreational fishing began in Guinea-Bissau in the late 1980s, with the emergence of the Bijagos archipelago as a tourist destination (CLPV 2012). Therefore, we assumed the number of recreational fishers was zero in 1988 and filled in the gaps with linear interpolations. We divided the resulting estimate by 2 for the years when there was a *coup d'état* and/or civil war, i.e., 1998, 2003 and 2009 (Table 4). To estimate the catch per fisher, we collected species and weight catch data from 30 *Youtube* videos documenting the experience of recreational fishers. From these, we could assemble catch data for 25 tourists and 17 fishing days, and estimated the catch per day per tourist by dividing the resulting total catch by the number of tourists and filtering out the released catch (representing 12%). The CPUE was then estimated at 18.7 kg·tourist^{-1}·day^{-1}. The annual catch is the product of the CPUE by the number of tourists per year by the number of days. We also

[1] http://www.fishipedia.com/destinations/guinea-bissau/ accessed on 17/05/2013
[2] http://www.worldsportfishing.com/by-destination/guinea-bissau/guinea-bissau-prices-details/ accessed on 17/05/2013

derived the catch composition using visual recognition of species, matched with average weight data from FishBase (www.fishbase.org), which when multiplied by the number of individuals, allowed for the estimation of catch percentage per taxon (Table 5).

Table 4. Estimation of the number of recreational fishers in Guinea Bissau.

Year	Fishers	Event
1950-1988	0	See text
1989	*105*	
1990	*210*	
1991	*316*	
1992	*421*	
1993	*526*	
1994	*631*	First elections
1995	*737*	
1996	*842*	
1997	*947*	
1998	*526*	Civil war
1999	*1,157*	
2000	*1,262*	
2001	1,368	
2002	*1,380*	
2003	*696*	*Coup d'état* / Period of unrest
2004	*1,404*	Mutiny of military faction / Period of unrest
2005	*1,416*	
2006	*1,428*	
2007	*1,440*	
2008	*1,452*	
2009	*732*	*Coup d'état*
2010	*1,476*	
2011	*1,488*	
2012	1,500	Death of president / *Coup d'état*

Table 5. Taxonomic breakdown for the recreational fishery in Guinea Bissau.

Common name	Scientific name	%
Barracudas	*Sphyraena barracuda*	33
Carangids or jacks	Carangidae	14
Cobia	*Rachycentron canadum*	19
Crevalle jack	*Caranx hippos*	9
Leerfish	*Lichia amia*	6
Marine fishes nei	-	5
Guinean snapper	*Lutjanus agennes*	3
Groupers	*Epinephelus* spp.	2
Meagre	*Argyrosomus regius*	2
Blackchin guitarfish	*Rhinobatos cemiculus*	2
Nurse shark	*Ginglymostoma cirratum*	2
Sparids	Sparidae	1
Sharks	Selachimorpha	1
Requiem sharks	*Carcharhinus* spp.	1

Industrial fishing

Industrial fishing in Guinea Bissau is conducted by foreign vessels chartered or reflagged to Guinea Bissau, under private or partnership agreements. Although these vessels may fly the flag of Guinea Bissau, they are not considered domestic vessels (Gomes Barbosa 2009). Catches made under these agreement are generally landed elsewhere, notably in the Canary Islands (Spain) and Senegal (Anon. 2009) and are not reported to Guinea Bissau (COPACE 1981; Anon. 2010), nor anywhere else. Even the presence of observers onboard was revealed to be ineffective, including on EU vessels (Anon. 2009). Fleets (or flags) from many countries operated in the waters of Guinea Bissau, notably China, Korea, the EU, Russia, Cyprus,

Senegal, Sierra Leone, Panama, Honduras, St Vincent and Grenadine, Morocco and Mauritania (DINÂMICA 2008). However, data on the vessel numbers and other information were scarce and often contradictory.

As one source stated that industrial fishing in Guinea Bissau was initiated in the mid-1950s (Chavance 2004), we set its start in 1955, and performed a series of linear interpolations to complete the effort time series for each country (Table 6). We then estimated the CPUE from three different fleet categories when data were available. For Russia, 68 pelagic trawlers (4,000 to 6,000 GRT) operating between 1981 and 1991 caught around 130,000 t·year^{-1} of small pelagics (DINÂMICA 2008), which corresponds to a CPUE of 1,912 t·vessel^{-1}·year^{-1}. Given the recent interest in the exploitation of small-pelagics by large trawlers in Guinea Bissau and the absence of evidence of small-pelagic over-exploitation, we assumed a constant CPUE over time between 1950 and 2010. For China, operating cephalopod, shrimps and fish trawlers (Anon. 2013), we estimated from data in Pauly *et al.* (2013), a CPUE of 1,200 t·vessel^{-1}·year^{-1} between 2000 and 2010. Based on the fact that these stocks are overexploited, we assumed the CPUE was 20% higher in 1950 compared to 2000 and then interpolated linearly. The use of motherships (which take small pirogues and artisanal fishers onboard to fish for periods up to 3 months) by Korea in Guinea Bissau started in 2000. These 'reefers' were taking up to 40 pirogues of a Senegalese type (Anon. 2013), operating similarly to the artisanal *nhominka* fleet, with a CPUE of 30 t·pirogue^{-1}·year^{-1} in 2000. However, they were operating only half of the year in Guinea Bissau, i.e., 600 t·reefer^{-1}·year^{-1} when multiplied by the total number of pirogues onboard each vessel. The efficiency and production per boat taken onboard increased during the last decade at an alarming extent (Anon. 2013); therefore we assumed the CPUE increased by 20% in 2010 compared to the CPUE of 2000, i.e., 720 t·reefer^{-1}·year^{-1}. For the rest of the fleet, catches were estimated at 60,000 t·year^{-1} of mostly demersal species for a total fleet of 145 vessels (Dia and Bedingar 2001), i.e., a CPUE of 414 t·vessel^{-1} for 1996. Given the over-exploitation of demersal taxa, we assumed the CPUE was 20% higher in 1950 and 10% lower in 2010, and then interpolated linearly. We then multiplied the effort by the corresponding CPUE to estimate industrial catches per country from the waters of Guinea Bissau between 1950 and 2010.

Table 6. Flag composition of the industrial fleet operating in Guinea Bissau, 1950-2010.

Year	Russia[d]	China	Motherships (Korea)	Europe	Korea	Japan	Africa	References
1950-1955	0	0	0	0	0	0	0	
1956	*0*	*0*	*0*	*4*	*1*	*0*	*1*	
1957	*1*	*0*	*0*	*8*	*3*	*1*	*1*	
1958	*1*	*0*	*0*	*11*	*4*	*1*	*2*	
1959	*1*	*0*	*0*	*15*	*5*	*1*	*2*	
1960	*2*	*0*	*0*	*19*	*7*	*1*	*3*	
1961	*2*	*0*	*0*	*23*	*8*	*2*	*4*	
1962	*2*	*0*	*0*	*27*	*9*	*2*	*4*	
1963	*3*	*0*	*0*	*30*	*10*	*2*	*5*	
1964	*3*	*0*	*0*	*34*	*12*	*2*	*5*	
1965	*3*	*0*	*0*	*38*	*13*	*3*	*6*	
1966	*4*	*0*	*0*	*42*	*14*	*3*	*6*	
1967	*4*	*0*	*0*	*46*	*16*	*3*	*7*	
1968	*4*	*0*	*0*	*49*	*17*	*3*	*8*	
1969	*5*	*0*	*0*	*53*	*18*	*4*	*8*	
1970	*5*	*0*	*0*	*57*	*20*	*4*	*9*	
1971	*5*	*0*	*0*	*61*	*21*	*4*	*9*	
1972	*6*	*0*	*0*	*65*	*22*	*4*	*10*	
1973	*6*	*0*	*0*	*68*	*24*	*5*	*11*	
1974	*6*	*0*	*0*	*72*	*25*	*5*	*11*	
1975	*7*	*0*	*0*	*76*	*26*	*5*	*12*	
1976	7	0	0	80	27	5	12	FAO (1979)
1977	*27*	*0*	*0*	*94*	*29*	*6*	*13*	
1978	*48*	*0*	*0*	*107*	*30*	*6*	*13*	
1979	68	0	0	121	31	6	13	Cissé (1980)
1980	*68*	*0*	*0*	*123*	*30*	*6*	*13*	
1981	*68*	*0*	*0*	*124*	*28*	*5*	*13*	
1982	*68*	*0*	*0*	*126*	*27*	*5*	*14*	
1983	*68*	*0*	*0*	*127*	*26*	*5*	*14*	
1984	*68*	*3*	*0*	*129*	*24*	*5*	*14*	[a]
1985	68	6	0	130	23	4	14	Weber and Durand (1986)
1986	*68*	*9*	*0*	*132*	*21*	*4*	*15*	
1987	*68*	*11*	*0*	*133*	*20*	*4*	*15*	
1988	*68*	*14*	*0*	*135*	*18*	*4*	*15*	
1989	*68*	*17*	*0*	*136*	*17*	*3*	*15*	
1990	15	20	0	138	16	3	16	Kebe *et al.* (1993)
1991	15	17	0	123	21	3	24	Kebe *et al.* (1993)
1992	15	20	0	79	19	3	14	Kebe *et al.* (1993)
1993	*14*	*20*	*0*	*81*	*20*	*2*	*13*	
1994	*14*	*21*	*0*	*83*	*22*	*2*	*12*	
1995	*13*	*21*	*0*	*85*	*24*	*2*	*10*	
1996	13	21	0	88	25	2	9	Anon. (2009)
1997	12	21	0	90	27	2	7	Anon. (2009) [c]
1998	11	22	0	92	29	2	6	Anon. (2009)
1999	11	22	0	94	31	1	5	Anon. (2009)
2000	10	34	23	109	32	14	3	Anon. (2009), Anon. (2013)
2001	5	31	21	101	9	2	3	Anon. (2009), Dia and Bedingar (2001) and Anon. (2013)
2002	6	33	20	108	18	7	3	SOFRECO (2002) and Anon. (2013)
2003	6	32	18	102	22	9	4	Anon. (2013)
2004	5	30	17	91	17	6	4	Anon. (2010) and Anon. (2013)
2005	5	25	15	74	34	1	12	Anon. (2009), Gomes Barbosa (2009), Anon. (2013)
2006	5	34	13	49	20	3	15	Anon. (2010), Gomes Barbosa (2009), Anon. (2013)
2007	5	27	11	59	22	2	17	Anon. (2009), Gomes Barbosa (2009), Anon. (2013)
2008	4	19	8	84	12	4	3	Anon. (2009), Anon. (2013)
2009	4	19	6	56	10	4	0	Anon. (2009), Anon. (2013)
2010	4	19	4	56	10	4	0	Anon. (2013)

a) Europe started agreements with Guinea in 1980 (Anon. 2010);
b) China started fishing in 1984 (Anon. 2010);
c) In 1997, 202 licenses were issued for US $ 16 million; half the licenses went to EU countries, the other half to Senegal, Japan and chartered vessels (Dia and Bedingar 2001);
d) The former USSR was Russia (DINÂMICA 2008).

To investigate the real ownership of vessels flying Belizean flags of convenience (FoC), we cross-checked the most recent position of vessels flying Belizean flag listed in www.grosstonnage.com (accessed on 15/05/2013) with the reflagging and ownership history, and inferred the real ownership. Of the total Belize vessels, 16% were Japanese, 6% Norwegian, 15% Spanish, 2% Swedish, 15% Russia, 12% Chinese, 8% Ghanaian, 6% Ukrainian, 2% Italian, and 15% from Iceland, the UK, the United States and others. Only 4% of these vessels, owned by Japanese firms, appear to be operating within the EEZ of Guinea Bissau[3]. We applied the same method to the flags of Panama, St Vincent and Grenadine, and Honduras, while vessels from Togo were assumed to be of Spanish ownership.[4] Twenty-one percent of Panama-flagged vessels were owned by South Korean companies and the remaining was divided between 20 other countries. Assuming that Panama-flagged vessels operating in Guinea Bissau were of mostly of South Korean origin aligns well with similar conclusions for neighbouring Guinea (Belhabib *et al.* 2013). Following the same approach, vessels flagged to St Vincent and Grenadines were assigned predominantly to Russian (30%) and Spanish companies (26%), while Japan and Latvia and others represent 13%, 17% and 13% of the fleet flagged to St Vincent and Grenadine, respectively. However, most of the vessels flagged to Russia were based and/or operating in Namibia; thus, we concluded that vessels flagged to St Vincent and Grenadines operating in Guinea Bissau most likely had a Spanish ownership. For the Honduran flag, most of the fleet is owned by Taiwanese and Chinese companies (71%). Given the diplomatic relations and the history between Guinea Bissau and Taiwan in the past, we assumed that the fleet flying Honduran FoC and operating in Guinea Bissau was from Taiwan (Table 6).

To disaggregate catches onto taxa, we used the species disaggregation by Anon. (2009) and subdivided the major categories by the number of taxa represented in each category for African and FoC countries (Table 7). For example, the category 'mackerel, horse mackerel and sardinella' (48%) was divided into 3 taxa with 16% each. For Russia, we used the species disaggregation provided by ter Hofstede and Dickey-Collas (2006) and for Europe and Korea (i.e., mostly demersal fleets), we used the species disaggregation provided by Belhabib *et al.* (2013) for Guinea (Table 7). Similarly, we applied the species breakdown provided by Lesnoff *et al.* (1999) to Chinese catches.

[3] Of the total, 21% were located in Dakhla (Western Sahara), 18% in Las Palmas, 14% in Conakry (Guinea), 7% in Cote d'Ivoire, 10% in Ghana, 4% in Cape Town (South Africa), 7% in Namibia, 4% in China, and 4% in Panama.

[4] http://www.stopillegalfishing.com/togo.php accessed on 13/06/2013

Table 7: Species disaggregation for industrial catches (in %) by foreign catches in Guinea Bissau

English name	Scientific name	%
African and Flag of Convenience countries[a]		
Mackerel	*Scomber* spp.	16.00
Horse Mackerel	*Trachurus* spp.	16.00
Sardinella	*Sardinella* spp.	16.00
Breams	Sparidae	8.00
Sweetlips	Haemulidae	8.00
Croakers	Sciaenidae	8.00
Catfishes	Ariidae	8.00
Soles	*Cynoglossus* spp.	8.00
Cuttlefish	*Sepia* spp.	3.00
Octopus	*Octopus* spp.	3.00
Tuna	Thoninnae	5.00
Shrimps	*Penaeus* spp.	1.00
Crabs	*Callinectes* spp.	1.00
EU and Korea[b]		
Clupeidae	Clupeidae	0.90
Corakers	Scianidae	40.00
Breams	Sparidae	6.20
Marine fishes nei	-	4.00
Sharks	Selachimorpha	1.70
Crabs	Callinectes spp.	2.60
Shrimps	*Penaeus* spp.	19.00
Cephalopods	Cephalopoda	25.00
Tuna	Thoninnae	0.30
Russia[c]		
Cunene horse mackerel	*Trachurus trecae*	3.70
Round sardinella	*Sardinella aurita*	63.80
Flat sardinella	*Sardinella maderensis*	4.60
Chub mackerel	*Scomber japonicus*	9.30
European pilchard	*Sardina pilchardus*	12.90
Marine fishes nei	-	5.70
China[d]		
Meagre	*Argyrosomus regius*	0.44
Catfishes	Ariidae	2.03
Triggerfish	*Balistes* spp.	0.10
Carangidae	Carangidae	0.94
Cephalopods	Cephalopoda	18.93
Herrings	Clupeidae	4.75
Soles	*Cynoglossus* spp.	1.01
Breams	Sparidae	2.68
African sicklefish	*Drepane africana*	0.43
Sharks and rays	Elasmobranchii	0.30
West African ladyfish	*Elops lacerta*	0.11
Groupers	*Epinephelus* spp.	0.35
Bonga shad	*Ethmalosa fimbriata*	8.75
Southern pink shrimp	*Farfantepenaeus notialis*	0.05
Lesser African threadfin	*Galeoides decadactylus*	2.96
Sweetlips	Haemulidae	2.07
Snappers	*Lutjanus* spp.	0.32
Marine fishes nei	-	18.64
Hakes	*Merluccius* spp.	0.13
Marine crustaceans nei	-	0.05
Mullets	Mugilidae	0.41
Octopus	*Octopus* spp.	0.00
Shrimps	*Penaeus* spp.	0.02
West African goatfish	*Pseudupeneus prayensis*	0.31
Royal threadfin	*Pentanemus quinquarius*	0.18
Perch-like fish	Perciformes	0.55
Flatfishes	Pleuronectiformes	0.03
Giant African threadfin	*Polydactylus quadrifilis*	0.22
Grunts	*Pomadasys* spp.	0.71
Corakers	*Pseudotolithus* spp.	9.36
European pilchard	*Sardina pilchardus*	0.01
Sardinella	*Sardinella* spp.	2.61
Tuna	Scombridae	9.79
Cuttlefish	*Sepia* spp.	2.01
Catfishes	Siluriformes	1.37
Soles	*Solea* spp.	4.34
Barracudas	*Sphyraena* spp.	0.68
Torpedo (ray)	*Torpedo* spp.	0.50
Jack mackerels	*Trachurus* spp.	0.16
Largehead hairtail	*Trichiurus lepturus*	0.01
Drums	*Umbrina* spp.	0.11

[a] (Anon. 2009)
[b] (Belhabib *et al.* 2013)
[c] (ter Hofstede and Dickey-Collas 2006)
[d] (Lesnoff *et al.* 1999)

Illegal and unregulated fishing

The number of foreign fishing vessels operating without a license in Guinea Bissau was estimated at 33% of the industrial fleet for 2005 (Agnew *et al.* 2010), i.e., 47 vessels. For 2007, Anon. (2009) estimated the number of industrial vessels operating in Guinea Bissau at 30, a number that we assumed constant between 2007 and 2010. We interpolated the effort for 2006 (39 vessels), and estimated an industrial CPUE of 573 t·vessel^{-1} for 2005, 622 t·vessel^{-1} for 2006, 591 t·vessel^{-1} for 2007, 538 t·vessel^{-1} for 2008, 585 t·vessel^{-1} for 2009 and 580 t·vessel^{-1} for 2010, by dividing the total industrial catch (legal segment) by the total number of legal vessels per year. We then multiplied these CPUEs by the corresponding number of illegal vessels, and estimated illegal catches between 2005 and 2010. Then we interpolated from zero in 1955, when industrial fishing began in Guinea Bissau to the first estimate in 2005. Catches taken within the EEZ-equivalent waters of Guinea Bissau prior to the EEZ declaration by Guinea Bissau in 1986 are considered 'unregulated' but legal. Unregulated activities are conducted mostly by China and Korea, and to a lesser extent by the EU (Italy) (Agnew *et al.* 2010; Anon. 2013). Therefore, we assumed that between 1955 and 1983, 100% of catches were Korean, and then between 2000 and 2010 Chinese and Korean catches each represented 45% of the illegal catch, and 10% were Italian. We interpolated these percentages and completed the time series. Thereafter, we multiplied these percentages by total estimated illegal and unregulated catches. We used the same species breakdown as for the legal component of the industrial fishery.

Discards

Discards of the trawl fishery in Guinea Bissau are estimated at 87% of the catch (Kelleher 2004), i.e., 6.7 times the landings for 2004, and between 60 and 62% for 2010 (Anon. 2009), i.e., 1.5 times the landings. While these estimates are strongly divergent, the over-exploitation of fish species might have led to keeping more by-catch, or selling the latter to artisanal fishers, a pattern observed also in Liberia, Senegal and Ghana. Therefore, we conservatively used the latter rates for the demersal fleets. We separated out demersal from pelagic catches to account for the demersal portion of the retained catch, then applied the latter discard rate to demersal catches between 1950 and 2010. The taxonomic composition of the discards was documented by Caverivière and Rabarison Andriamirado (1988) for the southern areas of Senegal as including bigeye grunt (*Brachydeuterus auritus*), lesser African threadfin (*Galeoides decadactylus*), Atlantic bumper (*Chloroscombrus chrysurus*), cuttlefish (*Sepia* spp.), largehead hairtail (*Trichiurus lepturus*), catchfishes (*Arius* spp.), croakers (*Pseudotholithus* spp.), and Guinean tonguesole (*Cynoglossus monodi*). Given the similar profile of the fleets operating in both countries, we assumed this catch composition also applies to Guinea Bissau discards. We allocated an equal percentage to each of these taxa (i.e., 12.5%).

RESULTS

Artisanal

Total catches by the artisanal fleets operating in Guinea Bissau were estimated at 1.06 million t between 1950 and 2010. Catches increased from 7,100 t in 1950 to a peak of 33,000 t in 2000 (Figure 2). The small artisanal sector operating *nhominkas* between 1950 and the early 1970s caught between 7,100 t in 1950 and 14,000 t in 1970 (Figure 2), while catches by the Bissau-Guinean (*pailão*) fishers were estimated at 344,000 t between 1974, when they started, and 2010. Bissau-Guinean catches peaked at around 17,000 t in 2000, then declined rapidly to around 11,000 t in 2010 (Figure 2). Total catches landed in Guinea Bissau (alluded herein as catches by the two ethnic craft types, (*nhominka* and *pailão*) were lower than catch estimates by Failler (2005) between 1991 and 1997, with an average 25,600 t·year^{-1} estimated herein, compared to 34,000 t·year^{-1} estimated by that author (Figure 2). Reconstructed catches were thereafter similar to those provided by Gomes Barbosa (2009) and Anon. (2009) during the 1998-2009 time period (Figure 2). Artisanal catches landed in Guinea Bissau were dominated by bonga (*Ethmalosa fimbriata*; 50% of artisanal) as well as meagre (*Argyrosomus regius*; 16.3% of artisanal) and shrimp (Penaeus; 9.3% of artisanal).

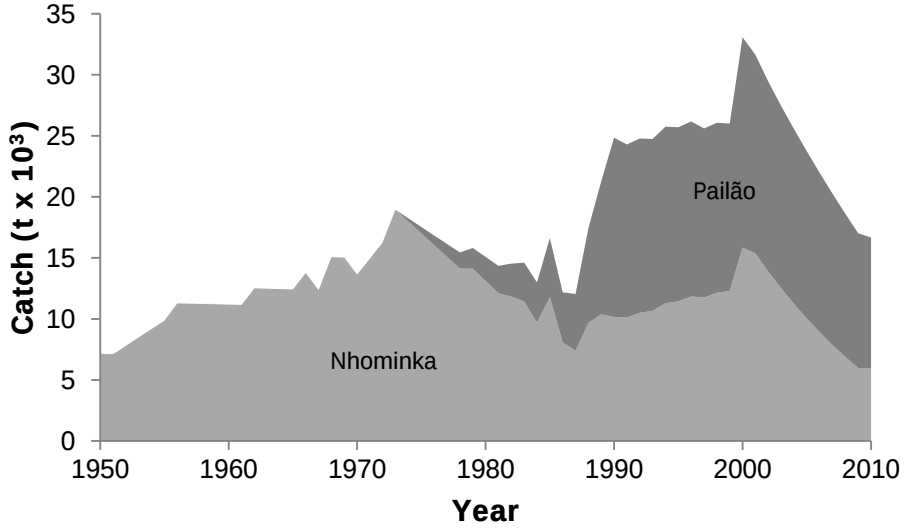

Figure 2. Reconstructed artisanal catches (Nhominka and Pailão) from Guinea Bissau, 1950-2010.

Subsistence

Subsistence catches totalled 535,000 t between 1950 and 2010, which is the equivalent of around half of the artisanal reconstructed catches landed in Guinea Bissau. Subsistence catches increased from 6,400 t in 1950 to 7,000 t·year^{-1} in the late 1970s. Following the first development project, conducted in the Bijagos archipelago, subsistence catches increased at a fast pace, to around 11,000 t in 1999, after the 1998 civil war, which because of the decrease in artisanal catches, resulted in a further increase in subsistence catches to 16,700 t in 2010 (Figure 3). Taxonomically, the species the most commonly eaten in Guinea Bissau are reflected in the subsistence catch, i.e., mostly bivalvia (81%) and bonga (11%).

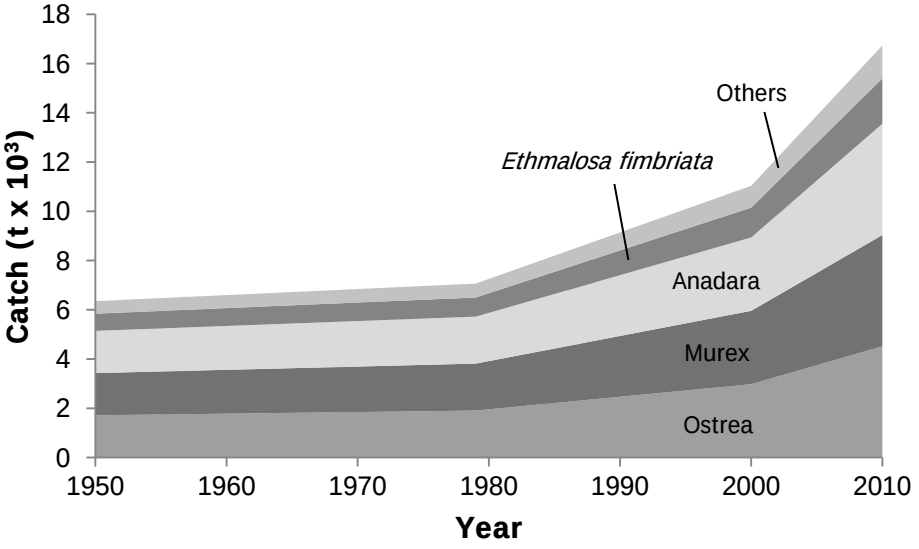

Figure 3. Reconstructed subsistence catches from Guinea Bissau, 1950-2010.

Recreational

Recreational catches increased overall since the introduction of sport fishing to Guinea-Bissau. Catches increased from zero in 1988 to a peak of 166 t in 2010 (Figure 4); catches frequently dropped, along with the numbers of recreational visitors to Guinea Bissau, due to political instability. Recreational catches, mostly from protected areas in the Bijagos archipelago, were dominated by carangids (i.e., jacks), cobias and barracudas (Figure 4).

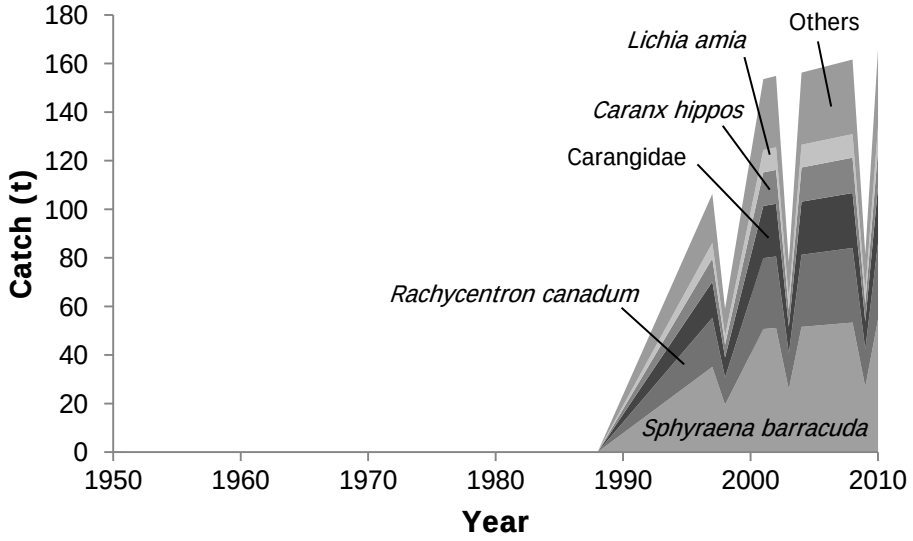

Figure 4. Reconstructed recreational catches from Guinea Bissau, 1950-2010.

Industrial

Industrial catches (all assigned to foreign beneficial ownership even if flying domestic flag) were estimated at 11.4 million t between 1950 and 2010, increasing from zero in 1955, when industrial fishing began in Guinea Bissau, to a peak of around 387,000 t in 1989 due to the operation of fleets from the former Soviet Union (Russia), then declined to 73,000 t in 2010.

Our estimates were 30% higher than the estimate by Kaczynski (2005) for 1981-1982, 52% lower than the estimate provided by Kaczynski (1989) for 1989, 41% higher than the estimates provided by Fond Africain de Developpement (2001) for 1995, around 30% higher than the estimate by Kaczynski and Djassi (2006) for 2003; 11% higher than the estimate by Gomes Barbosa (2009) for 2005. For 2009, our industrial reconstructed catch was similar to the estimate by Anon. (2009) with less than 1% difference (Figure 5a).

Catches by the EU dominated in the past between 1955 and the late 1970s, then started decreasing, and were slowly compensated for by Chinese catches, while the Russian presence was overwhelming between the late 1970s and the early 1990s with 130,000 $t \cdot year^{-1}$ on average (Figure 5a). Similarly, given the Russian presence, catches were dominated by small-pelagic species, notably sardinella, pilchards and mackerels in the past (Figure 5b). Conversely, demersal species (cephalopods, shrimps and sciaenids) dominate in more recent years, due to the presence of demersal fleets from South Korea, China and the EU.

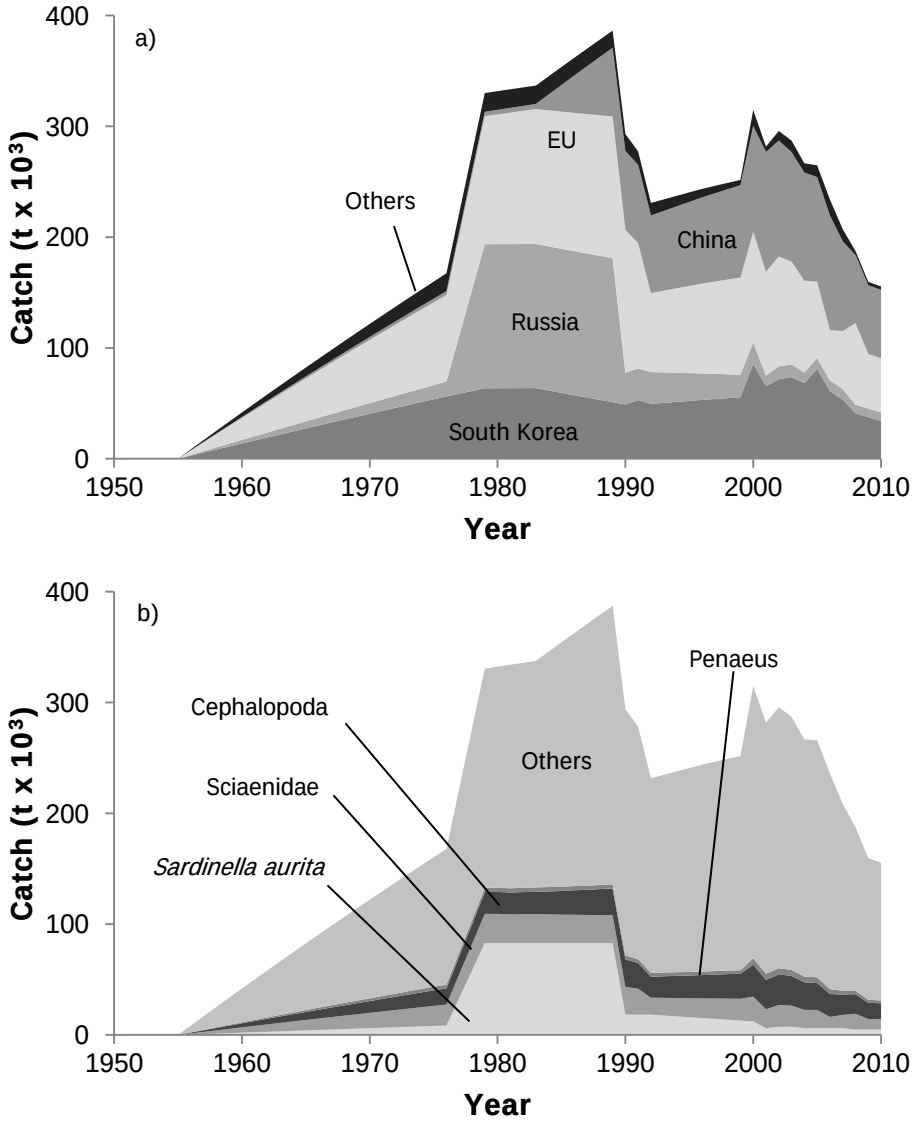

Figure 5. Reconstructed industrial catches from Guinea Bissau's EEZ a) by country and b) by taxon, 1950-2010.

Migrant fishers catches increased from zero in 1970 to 37,000 t·year^{-1} in 1995 (compared to 50,000 t·year^{-1} estimated by Anon. 2010), then to 51,000 t in 2005 (compared to 111,000 (Gomes Barbosa 2009)), and finally to 58,000 t in 2010 (Figure 2). Our conservative approach uses migrant catch data mainly from surveys and documented effort, while the approach by the literature is doubtful, non-transparent and resulting catches are highly divergent. Catches by migrant fishers were dominated by smoothmouth sea catfish (*Carlarius heudelotii*), with around a third of catches, and soles (*Cynoglossus* spp.) with 20% of catches.

Illegal and unregulated catches

Illegal and unregulated catches were estimated at 786,000 tonnes between 1950 and 2010. These catches increased from zero in 1950 to a peak of 27,000 t in 2005 and declined thereafter with slightly better monitoring to around 18,000 t in 2010. Illegal catches are taken mostly by Chinese and Korean vessels, given the assumptions stated above (Figure 6).

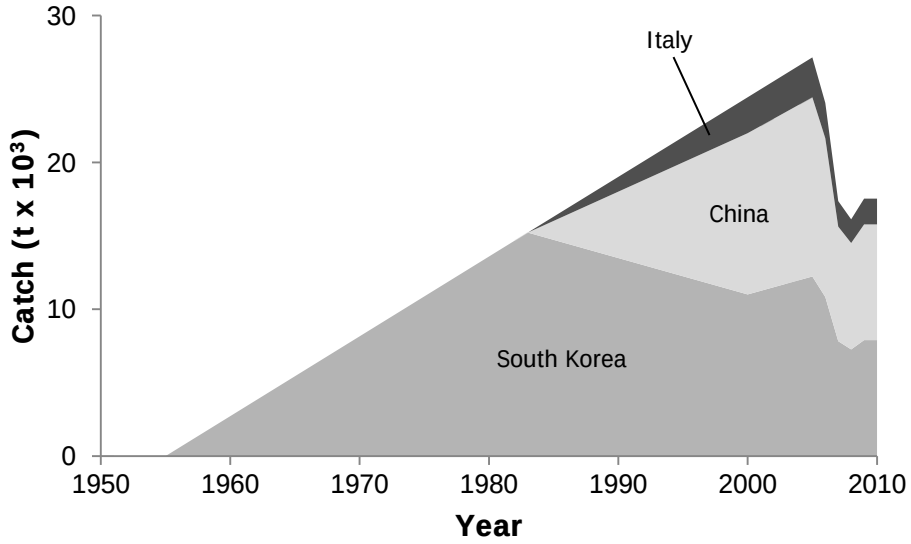

Figure 6. Reconstructed illegal and unreported catches from Guinea Bissau by country, 1950-2010.

Discards

Discards of both the legal and the illegal unregulated sectors were estimated at 5.2 million tonnes between 1950 and 2010, of which 3.9 million tonnes were generated by the legal industrial sector, about 3.7 times the artisanal domestic catch. Discards increased from zero in 1955 to a peak of 162,000 t in 2000 to decrease thereafter to around 82,000 t in 2010 (Figure 7).

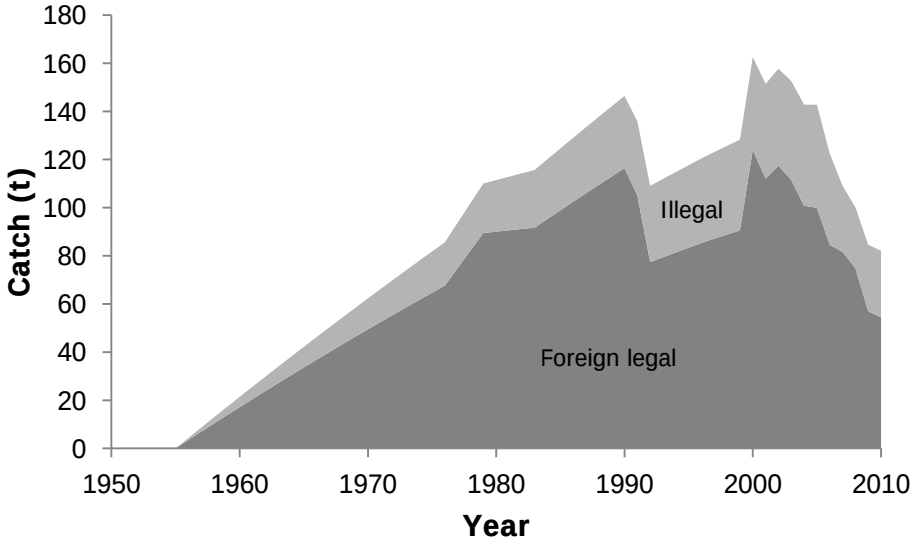

Figure 7. Reconstructed industrial discards from Guinea Bissau, 1950-2010.

Total catches

Reconstructed total catches from Guinea Bissau were estimated at 13.0 million tonnes between 1950 and 2010, of which 1.6 million tonnes were generated by Guinea Bissau as a flag state compared to 207,000 tonnes supplied to the FAO during the same time period, and 1.2 million tonnes by migrant fishers landing catches in Senegal. Total removals from Guinea-Bissau waters increased from around 13,000 t in 1950 (exclusively by small-scale fisheries) to a first peak of 420,000 t in 1989 (Figure 8a), a second peak of 359,000 t in 2000 and then

declined steadily to less than 189,000 t in 2010 (Figure 8a). Domestic catches increased slowly from 13,000 t in 1950 compared to 300 t supplied to the FAO, to a peak of 44,000 t in 2000 compared to 5,300 t supplied to the FAO, and then decreased to around 34,000 t in 2010 despite an increasing fishing effort (Figure 8b).

Taxonomically, domestic catches were dominated by bivalves and bonga shad and meagre catches caught mostly by the small-scale sectors. The contribution of fish species such as bonga shad, croakers, sciaenids, threadfins and meagre to the total catch, however, decreased over time and was compensated by increasing catches of bivalve (Figure 8c).

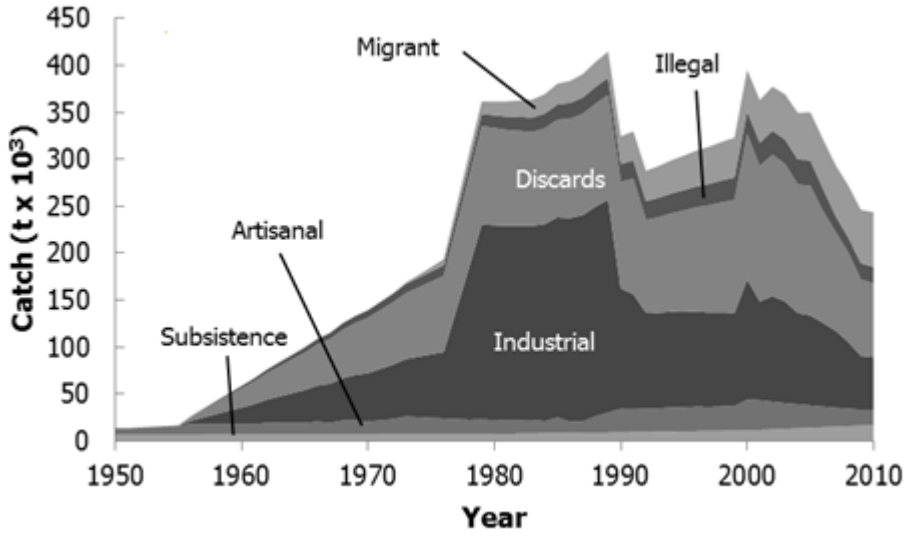

Figure 8. Reconstructed total catches (foreign and domestic) by sector from Guinea-Bissau EEZ, 1950-2010.

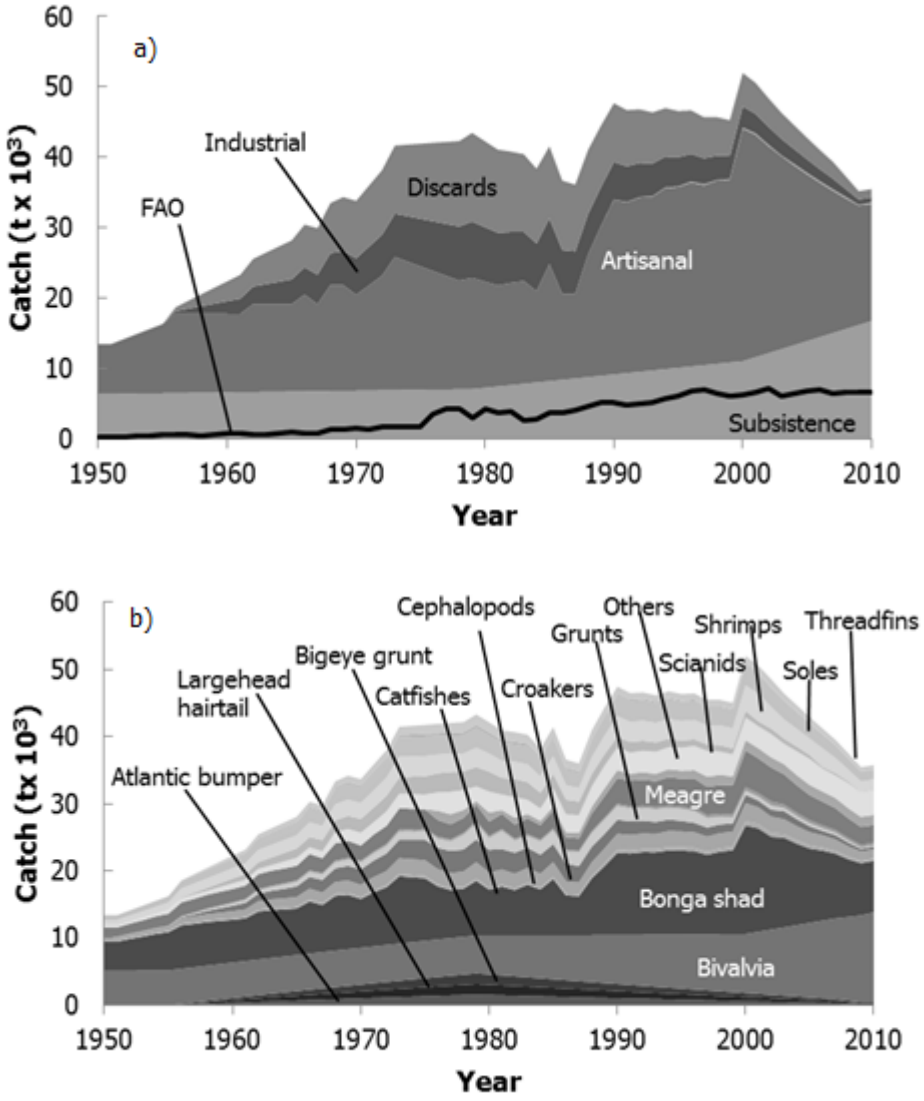

Figure 9. Reconstructed total domestic catch for Guinea Bissau, for 1950-2010 by a) sector, with official reported data overlaid as line graph; and b) by major taxa, with 'Others" consisting of 27 additional taxonomic categories.

DISCUSSION

Total removals from Guinea Bissau's EEZ were reconstructed at 13.0 million tonnes between 1950 and 2010, of which 1.6 million tonnes were domestic (small-scale) and around 503,000 tonnes caught by Guinea Bissau flagged industrial fleet. Catches by Guinea Bissau as a flag state were 10 times higher than the catch data supplied by the FAO (207,000 tonnes). The under-reporting component was significantly higher in the past, around 44 times as much as supplied to and by the FAO, and then decreased to be around 4 times.

Although, this work is the first comprehensive attempt to obtain a realistic estimate of removals from the EEZ of Guinea Bissau between 1950 and 2010, the literature contains earlier, but partial attempts. The estimates by Pires (1999), Failler (2005), IRD (2011) and Anon. (2009) for the artisanal sectors were either higher or similar to the reconstructed artisanal catch estimated herein. Estimates of industrial catches, on the other hand, were generally lower than those presented here and can probably be explained by differences in the methods and definitions previously used, which are often unclear.

Doubtful biomass estimates in Guinea Bissau's EEZ show a total of 479,000 t·year^{-1} of valuable species, of which 96,000 t·year^{-1} could be sustainably exploited (Gomes Barbosa 2009). However, such catch levels were reached, then exceeded already in the 1970s, with catches reaching a maximum of around 400,000 t·year^{-1} in the late 1980s. This can mean two things; (1) maximum sustainable yield and the corresponding biomass are strongly underestimated and/or (2) Bissau-Guinean fisheries are at the edge of collapse as catches are dangerously high. While these two possibilities are not exclusive, declining domestic catches for over a decade despite (or rather because of) an increasing effort are signs of overexploitation. The other sign is the decrease in the industrial catch, which according to Anon. (2013), declined because of unsustainable exploitation. In all cases, this MSY level appears to be lower than the Total Allowable Catch of small pelagics set at 100,000 t·year^{-1} (Anon. 2009).

Cyclic political crises in Guinea Bissau, and extreme poverty (Gomes Barbosa 2009) have certainly affected the behaviour of local populations and their interactions with fisheries resources. For example, catches declined significantly immediately after independence from Portugal, and after the 1998 civil-war. Catches increased rapidly with the introduction of motorized pirogues in the late 1980s, after which they stagnated, a sign of a failing development projects. On the other hand, poor populations are driven to compensate for the decline in fish supply due to decreasing artisanal catches by increasing subsistence catches, thus illustrating the importance of fish in the national diet and food security of the country. Fisheries, indeed could play a major role in rebuilding the country's economy, now further distorted by drug-smuggling, as also manifested in the $100,000 cars that the first author recently saw in the capital city of a country that ranks last in human development index in the world.

It is thus important to re-iterate the vital role that fisheries play in Guinea Bissau: of the 120,000 people employed by this sector, 52% are women, and all depend on fish as a source of revenue and basic food stable. Moreover, the value lost to Guinea Bissau because of illegal or undervalued foreign fishing (i.e., either by unlicensed vessels, or foreign vessels misreporting, or landing their catches elsewhere) and the discards they generate was here estimated at around $338 million US annually, which is almost as high as the value generated by drug smuggling in the country (Cornwell 2013). It is clear that Guinea Bissau does not have the capacity to process, or even land a large part of these catches *in-situ*, however, if an inferred 15% is used as the licence fee (Kaczynski 1989) for illegal vessels, this would mean that Guinea Bissau could capture as much as $15 million US annually. Furthermore, the value of catches by the foreign fleets ($238 million US) should be an incentive to impose sanctions on transshipping which is already illegal, enhance the level of monitoring, control and surveillance, and increase license fees.

ACKNOWLEDGEMENTS

We thank the MAVA Foundation for supporting the project "*Sea Around Us* in West Africa, research and research initiative", and acknowledge the support of the *Sea Around Us*, a collaboration supported by The Pew Charitable Trusts and the Paul G. Allen Family Foundation. D.B. thank Victorino Nahada and Djibril Blade from the Centre for Applied Fisheries Research of Guinea Bissau (Centro de Investigação Pesqueira Aplicada - CIPA) for their hospitality and transparency during a short visit to Guinea Bissau.

REFERENCES

Agnew D, Walmsley SF, Leotte F, Barnes C, White C and Good S (2010) West Africa regional fisheries project. Estimation of the cost of illegal fishing in West Africa.Final report, MRAG, London. 97 p.

Anon. (1994) Planificacao costeira da Guiné Bissau. Relatorio tecnico 1, UICN, Bissau. 150 p.

Anon. (2009) Contrat cadre pour la réalisation d'évaluations d'études d'impact et de suivi concernant les accords de partenariat dans le domaine de la pêche (FPA) conclus entre la Communauté européenne et les pays tiers. et plus généralement sur le volet externe de la Politique Commune de la Pêche : Ex-post evaluation of the current protocol to the Fisheries Partnership Agreement (FPA) between the European Union and Guinea Bissau and analysis of the impact of the future Protocol on sustainability. Final Report, Final report to the European Commission by Oceanic Dévelopement and MegaPesca Lda, Concarneau, France. 129 p.

Anon. (2010) Guinea-Bissau. Cashew and beyond: diversification through trade. Diagnostic trade integration study for the Enhanced Integrated Framework for Trade-related Technical Assistance. 150 p.

Anon. (2013) Industrial fisheries in Guinea Bissau. Transparent Sea. Available at: http://transparentsea.co/index.php?title=Guinea,Bissau:Industrial_fisheries [Accessed: 17/05/2013].

Belhabib D, Doumbouya A, Diallo I, Traoré S, Camara M, Camara OT, Copeland D, Gorez B, Harper S, Zeller D and Pauly D (2013) Guinean fisheries, past, present and 'future?'. pp. 91-104 *In* Belhabib D, Zeller D, Harper S and Pauly D (eds.), Marine fisheries catches in West Africa, 1950-2010. Fisheries Centre Reserach Reports 20 (3). Fisheries Centre, University of British Columbia, Canada.

Belhabib D, Koutob V, Gueye N, Mbaye L, Nhiamadio I, Mathews C, Lazar N and Pauly D (this volume) Lots of boats and fewer fishes: catch reconstruction for Senegal, 1950-2010. *In* Belhabib D and Pauly D (eds.), Admitting, first step towards filling the gaps of African fisheries data, 1950-2010. Fisheries Centre, Vancouver.

Bordonaro LI (2006) Living at the margins. Youth and modernity in the Bijago Islands (Guinea-Bissau). Doctor in Anthropology thesis, University Institute for Social Sciences, Business Studies and Technologies, Department of Anthropology, Bissau. 275 p.

Campredon P and Cuq F (2001) Artisanal fishing and coastal conservation in West Africa. Journal of Coastal Conservation 7(2001): 91-100.

Caverivière A and Rabarison Andriamirado GA (1988) Captures secondaires et rejets de la pêche crevettière à Penaeus notialis du Sénégal 111, CRODT, Dakar. 113 p.

Chavance P (2004) Towards reconstructing half a century of change in West African fisheries. pp. 113-132 *In* Chavance P, Ba M, Gascuel D, Vakily JM and Pauly D (eds.), Pecheries maritimes, ecosystemes et societes en Afrique de l'ouest. Un demi-siecle de changement. Actes du symposium international Dakar — Sénégal — 24-28 juin 2002. Collection des Rapports de recherche halieutique ACP-UE 15 (1)Bruxelles.

Cissé M (1980) Quelques informations sur la pêche maritime: les rendements de chalutage et la communaute des psarides en Guinée. *In* FAO (ed.), Report of the second ad hoc working group on coastal demersal stocks from southern Mauritania to Liberia (CECAF statistical division 34.3.1 and 34.3.3. Interregional fisheries development and management programme - INT/79/01980 (23). FAO, Rome.

CLPV (2012) Guine Bissau. Archipel des Bijagos. CLPV, Paris. 3 p.

COPACE (1981) Rapport de la 5e session du Groupe de travail de l'évaluation des ressources, Dakar, Sénégal, 15-17 octobre 1980. FAO Rapport sur les pêches 244. Organisation des Nations Unies pour l'alimentation et l'agriculture, Comité des pêches pour l'Atlantique Centre-Est, Rome. 133 p.

Cornwell R (2013) West African leader linked to $400m cocaine smuggling ring. The Independent.

Dia AK and Bedingar T (2001) Fishing sector support project. Republic of Guinea Bissau. Appraisal Report, African Development Fund. 24 p.

DINÂMICA (2008) Projet pour le développement rationel et durable du secteur de la Pêche en Guineé-Bissau. Projet pour le développement rationnel et durable du secteur de la

Pêche (INT/07/16M/SPA). DINÂMICA Gabinete de Estudos & stratégias Sar, Ministerio de Medio Ambiente y Medio Rural y Marino. 95 p.

ECOST (2007) Ecosystems, Societies, Consilience, Precautionary principle: Development of an assessment method of the societal cost for best fishing practices and efficient public policies. Guinea Bissau Case study presentation. INEP. 4 p.
Failler P (2005) Environment and Economics of Production and Transformation units. The case of the Farim/Cacheu, Mansoa and Geba/ Corubal Rivers. INEP, Bissau. 31 p.
FAO (1979) Project for the development of fisheries in the eastern central atlantic. CECAF/ECAF 78, CECAF, Rome. Available at: http://www.fao.org/docrep/003/X6585E/x6585e00.htm#Contents [Accessed: 17/06/2013].
Fernandes R (2012) Job satisfaction in the marine and estuarine fisheries of Guinea-Bissau. Social Indicators Research 109(1): 11-23.
Fond Africain de Developpement (2001) Rapport d'evaluation. Projet d'appui au secteur de la peche. Republique de Guinee Bissau.GUB/PAAF/2001/01, OCDW.
Garcia F (1992) O consumo de pescado na Guine-Bissau (Estimativa). FAO, Rome. 30 p.
Gomes Barbosa T (2009) Republique de Guinee Bissau. Secrétariat d'état a l'environnement et développement durable Bissau. 99 p.
INS (2009) Comptes nationaux de la Guinée-Bissau. Ministère de l'Économie, du Plan et de l'Intégration Régionale, Bissau. 44 p.
IRD (2011) Programme régional de renforcement de la collecte de données statistiques des pêches dans les états membres et de la création d'une base de données régionale de renforcement de collecte de données. Enquête cadre. GT n°1 -16 au 20 Mai 2011. IRD, Ouagadoudou. 32 p.
Kaczynski VM (1989) Foreign fishing fleets in the subSaharan West African EEZ. The coastal state perspective. Marine Policy 13(1): 2-15.
Kaczynski VM (2005) The IUU seafood trade in the West Africa region: impacts on environment and poverty. Overfishing, Global Trade, and Food Security Workshop. Sea Around Us Project
May 24, 2005. School of Marine Affairs, University of Washington, Dakar. 27 p.
Kaczynski VM and Djassi S (2006) Illegal activities in Marine Protected Areas: the case of Guinea-Bissau, West Africa. Jackson School of International Studies. University of Washington, Seattle, WA. 11 p.
Kebe M, Gallene J and Thiam D (1993) revista sectorial de pesca artesanal na Guine-Bissau. Relatório técnico 46, DIPA, Cotonou. 42 p.
Kelleher K (2004) Discards in the world's marine fisheries: an update. FAO Fisheries Technical Paper 470, FAO, Rome. 134 p.
Lesnoff M, Morize E and Traore S (1999) La pêcherie industrielle en Guinée: état et bilan des données disponibles. pp. 175-198 *In* Domain F, Chavance P and Diallo A (eds.), La pêche côtière en Guinée : ressources et exploitation. Insitut de recherche et de développement, Conakry.
Pauly D, Belhabib D, Blomeyer R, Cheung WWWL, Cisneros-Montemayor AM, Copeland D, Harper S, Lam VWY, Mai Y, Le Manach F, Österblom H, Mok KM, van der Meer L, Sanz A, Shon S, Sumaila UR, Swartz W, Watson R, Zhai Y and Zeller D (2013) China's distant-water fisheries in the 21st century. Fish and Fisheries doi: 10.1111/faf.12032.
Pires V (1999) ACP- EU training. Rapport national sur les peches en Guinée - Bissau. Cours ACP-UE sur la gestion des pêches et de la biodiversité, Dakar, Sénégal, du 12 au 23 avril 1999. EU, Dakar. 5 p.
Said AR (2007) Analyse des acteurs de la zone côtière. Le cas de la Guinée-Bissau. Programme « Capacités et connaissances de la FIBA ». FIBA, Bissau. 56 p.
SOFRECO (2002) Diagnostic strategique de filière agro-industrielles. Rapport Guinée-Bissau.765, SOFRECO, Clichy, France. 15 p.
ter Hofstede R and Dickey-Collas M (2006) An investigation of seasonal and annual catches and discards of the Dutch pelagic freezer-trawlers in Mauritania, Northwest Africa. Fisheries Research 77(2): 184-191.
Tvedten I (1990) The difficult transition from subsistence to commercial fishing. The case of the Bijagos of Guinea-Bissau. MAST 3(1): 119-130.
Weber J and Durand H (1986) Le secteur des pêches dans les pays de l'Afrique. Réunion préparatoire pour l'Afrique en vue de la première Consultation sur l'industrie de la pêche, Dakar (Sénégal), 16-19 septembre 1986.86-60897, Organisation des nations unies pour le developpement industriel, Paris. 29 p.